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DECT NR+ Webinar Series

15 June 2023, 3 PM CEST

DECT NR+ webinar series

- Welcome from the DECT Forum!
- Speakers today:

Host Roel Ottink
DECT Forum

Jussi Numminen
Wirepas

Kristian Saether
Nordic Semiconductor

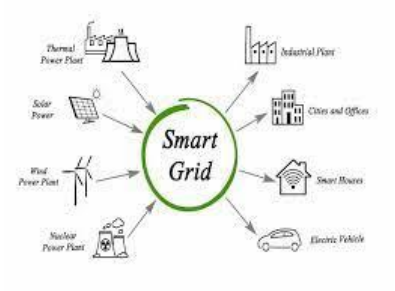
Dr. Andreas Wilzeck
Sennheiser

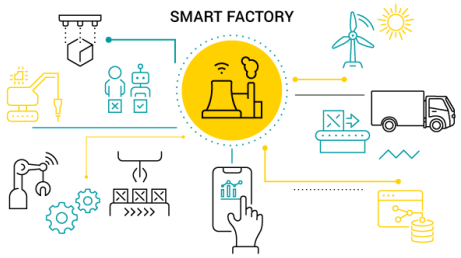
Some notes

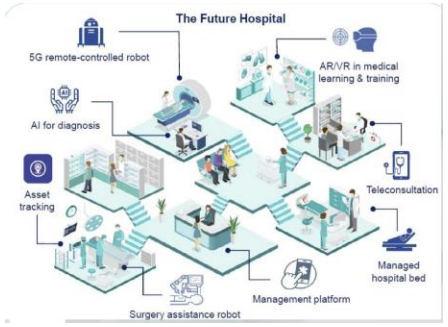
- The presentations will take around 30 minutes
- Questions:
  - Can be asked by using the ‘Questions’ button in the bottom righthand corner
  - Will be answered after the presentations
  - If there are too many to answer in today’s webinar then they will be answered afterwards
- FAQ page: https://www.dect.org/news.aspx?id=390
- The webinar will be recorded and made available to all who have registered

Purpose with the webinars

Applications and use cases







Features and benefits

Mesh networking

High density (mMTC)

Ultra Low Latency and reliability (URLLC)

Licenced & licence free operation

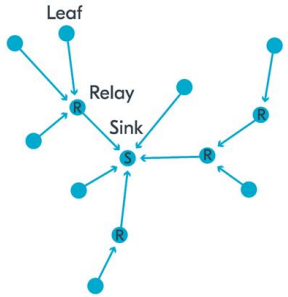
Dedicated frequency band

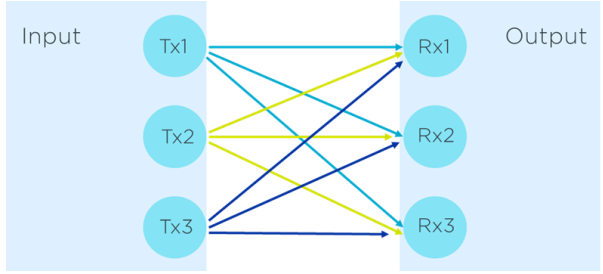
Private networking

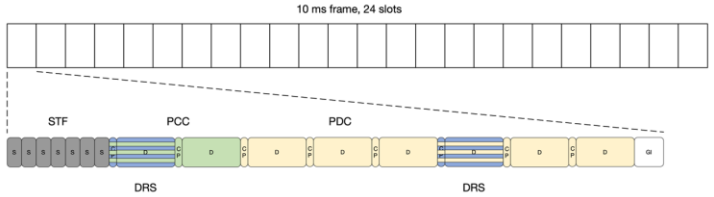
Self-healing and robust

Range

Technology foundation







What are we covering today

Which are the application areas and use cases:

- Smart metering & Smart grid
- Building management
- Industrial IoT
- Professional Audio and PMSE

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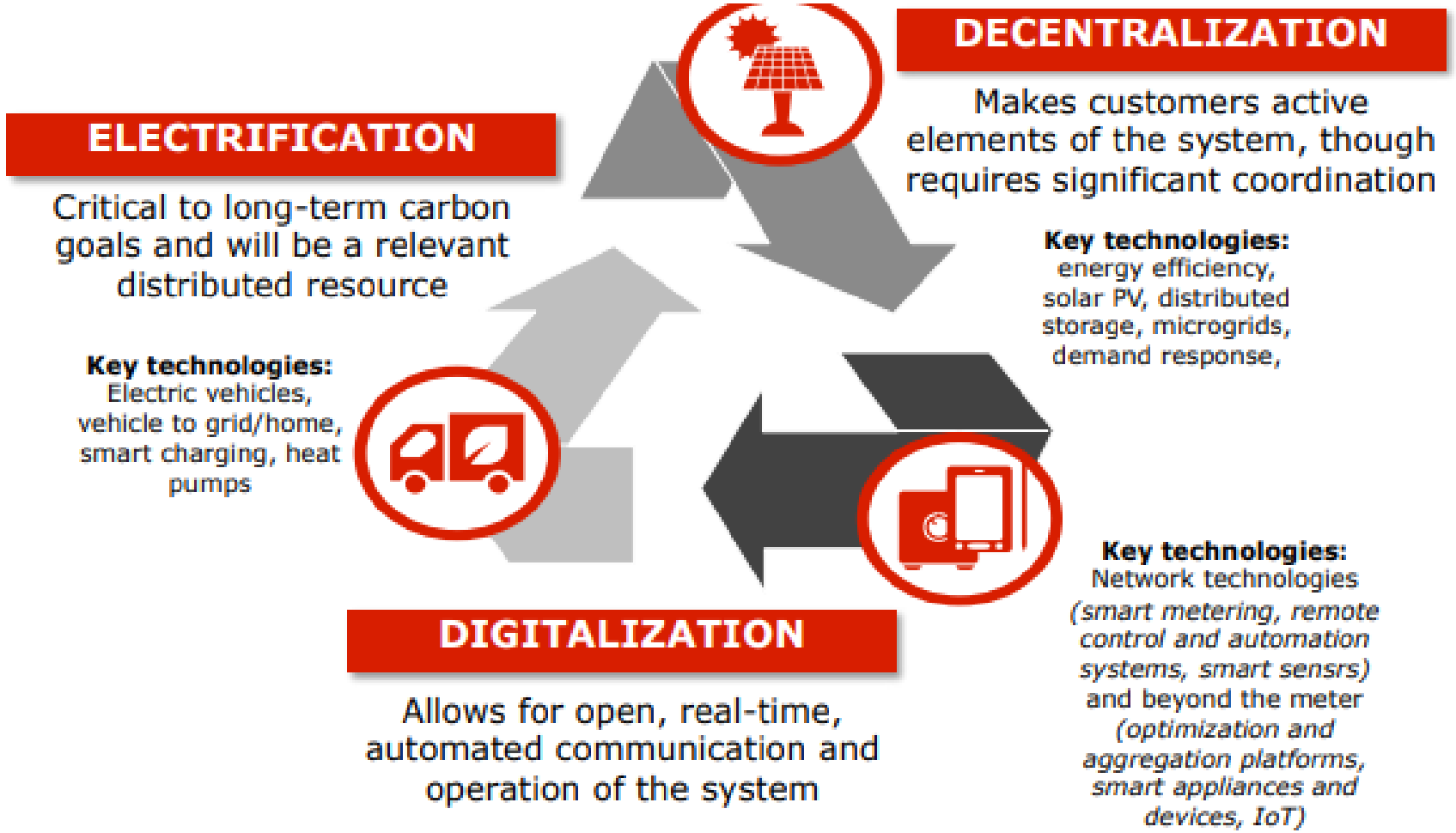
The Electricity Grid is transforming due to decarbonization



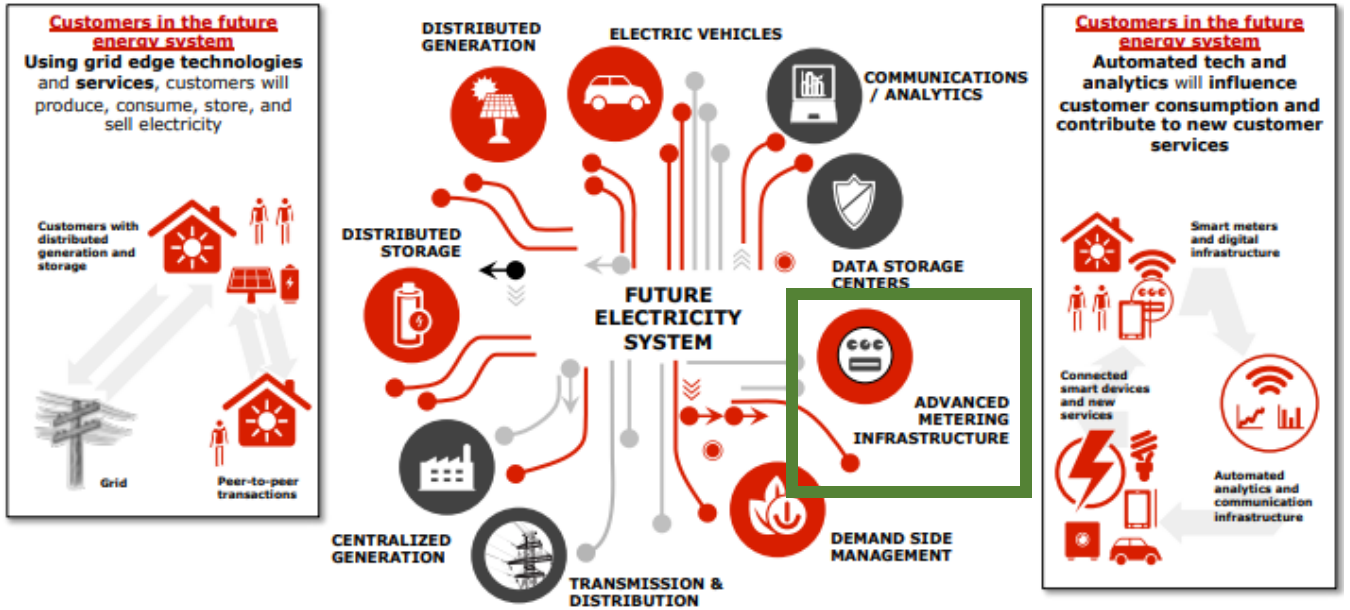
http://www3.weforum.org/docs/WEF_Future_of_Electricity_2017.pdf

Smart metering and Smart grid

Smart grid operational objectives for electricity distribution and transmission systems are:

- Seamless integration of renewable energy production into system
- Integration must be **affordable, reliable** and **accessible** for everyone to attend.

- **DECT NR+ affordability:**
  - Access to spectrum at 1,9 GHz is free and the cost of DECT NR+ deployment is low.
  - Cost of operation and maintenance is low.
  - Business sovereignity
- **DECT NR+ reliability:**
  - State of art radio design,
  - Autonomous operation adapting large networks and coverage (mesh topology).
- **DECT NR+ Accessibility:**
  - Anyone can participate in the energy and flexibility market,
  - Electricity grid operator can obtain real time status of the local consumption and production.



http://www3.weforum.org/docs/WEF_Future_of_Electricity_2017.pdf

Energy transition is possible with proven and reliable data of energy generation and consumption.

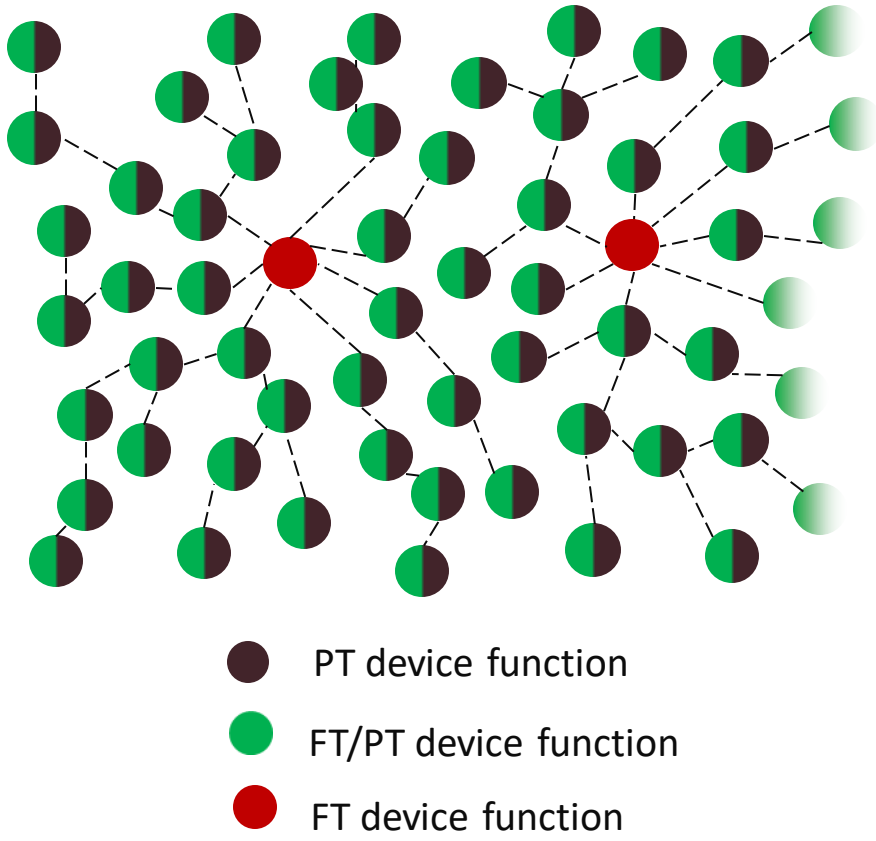
-> **Advanced metering infrastructure (AMI)** provides the data connection for this.
DECT NR+ unlocks the potential for future smart metering deployments thanks to advanced features .

Smart metering

Smart metering

- This is the largest Industrial IoT use case seen so far, 1,2B installed meter base globally today.
- Estimated up to 1,6B new or replacement meters installed until eof 2030.
- Multiple connectivity technologies have been used so far (PLC, WI-SUN, cellular, RF Mesh etc.)

- DECT NR+ supports the performance for next-generation metering requirements and overcoming technical and economic obstacles experienced in the field.



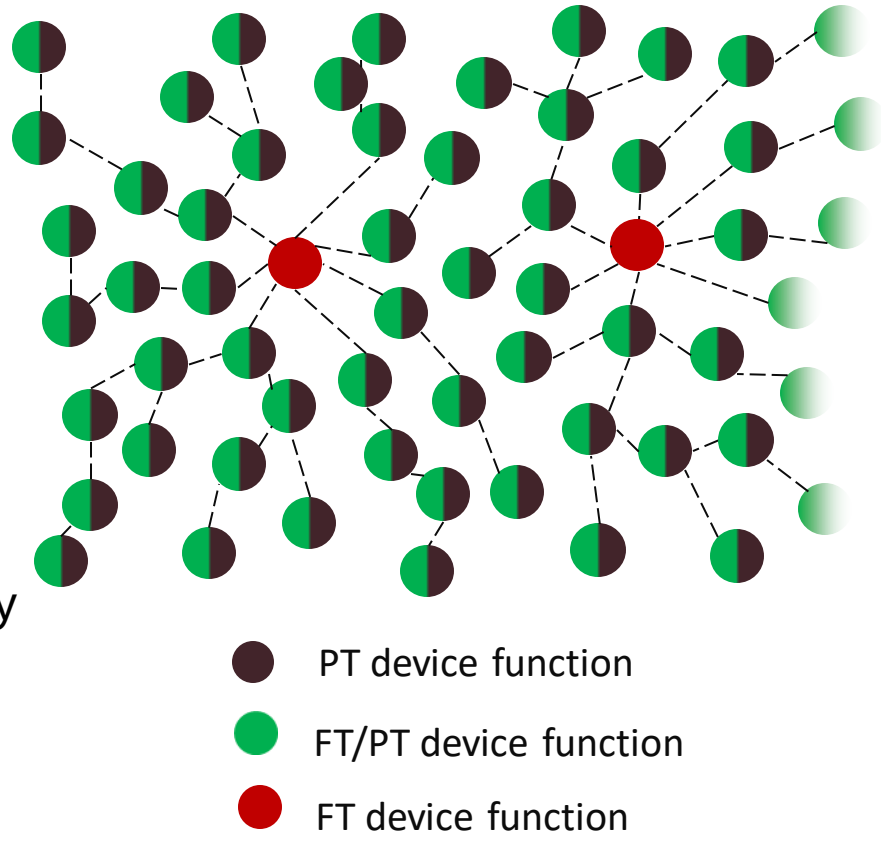
DECT NR+ Smart metering

Technology

- State of Art radio technology for performance, de-centralized and autonomous operation with mesh topology.
- 1,9 GHz spectrum and shared spectrum operation,
- Scaling up to millions (max. 4B) devices in one network

Governace

- Smart metering operator has full control of communication layer.
- DECT NR+ standard provides interoperability on communication layer.
- Smart meter application standard (DLMS) interworking is underway
- Open access to spectrum and possibilty for lisenced spectrum use.



Total cost of ownership over lifetime

- Network management cost over lifetime is low
- All devices are similar which is simplifying design and testing
- Equipment certification

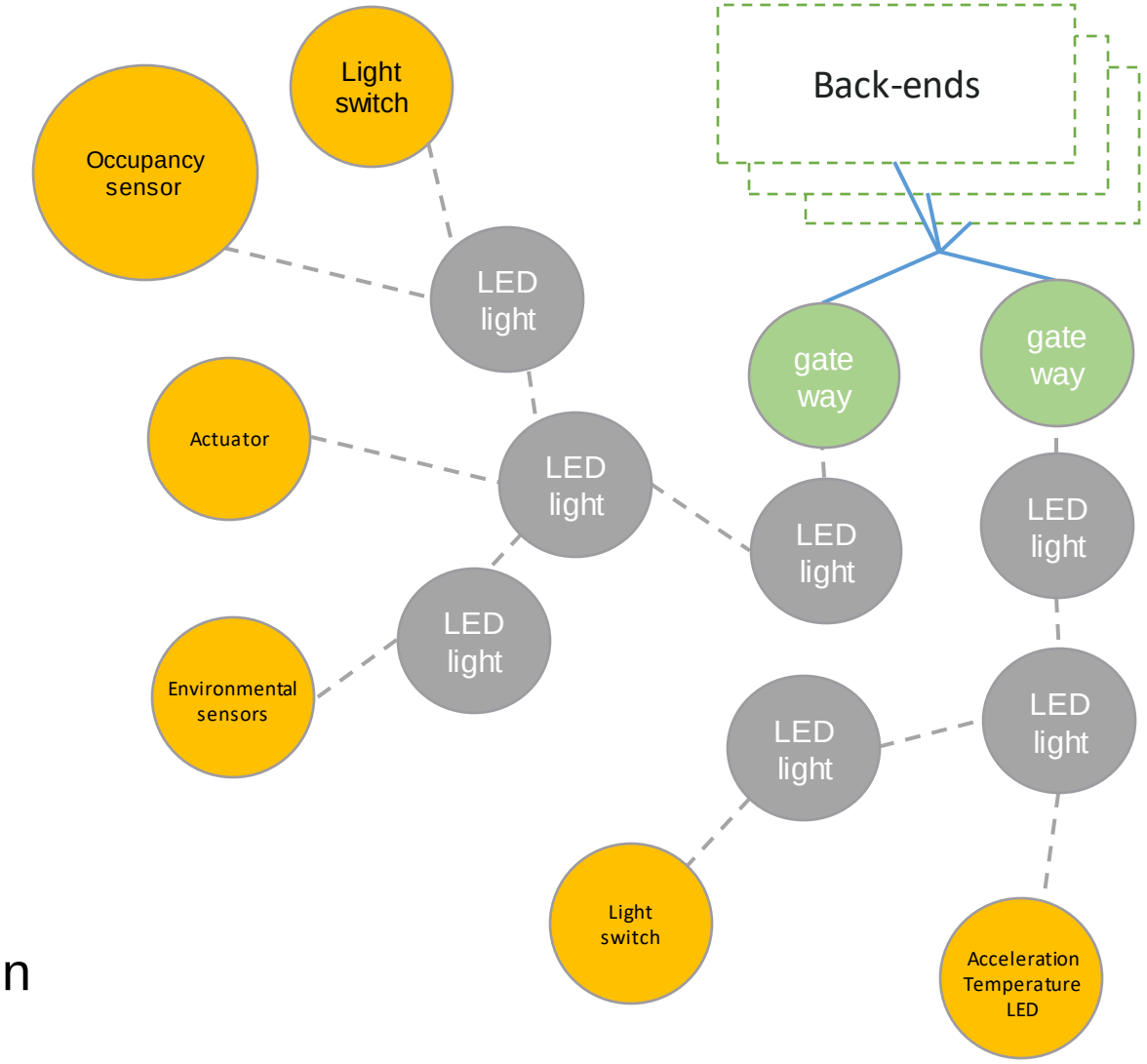
Building applications

DECT NR+ design objectivities for building use cases

- Lighting – requires low latency communication for lighting control.
- Mains powered lighting infra can serve as a communication backbone for other devices.
- Single network can support millions devices
  - Reliability
  - Simple network building and maintenance
  - Capacity increase is straightforward
- Collect data, manage and control devices with connectivity for multiple applications.

Building applications

- Security and emergency application
  - Emergency lighting
  - Fire detection
  - …
- Advanced maintenance
  - Environmental sensing
  - Water management
  - …
- Energy management
  - HVAC control
  - Intelligent lighting
  - …
- Building control back-end can locate on premises or cloud.



DECT NR+ Building applications

Key benefits

- Multiple device types and application protocols can operate in common network
  - DECT NR+ supports Application specific endpoints (DECT-2020 NR Endpoint Multiplexing Addresses (etsi.org)
  - Manufacturer specific data delivery (e.g. for selling maintenance services)
- Alternatively, DECT NR + supports the state of art shared spectrum operation
- Automatic network formation, minimal maintenance
  - Devices can change role between routing to non-routing on need basis, provides adaptivity for high density use
- 1.9 GHz spectrum use
- Multi gateway supporting for large systems and managing capacity
- Robust communication
  - OFDM access, channel coding, HARQ, autonomous network
- Data rates
  - Adaptive modulation and coding

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Industrial IoT

- The urgent need for IoT in Industrial
  - Massive cost savings opportunity, est to $1.2-3.7 trillion on factories alone* (Gartner)
  - Sensors, Automation, Remote Monitoring, Supply Chain Optimization, Digital Twins,
  - Predictive Maintenance, Security, Environmental reasons and much more

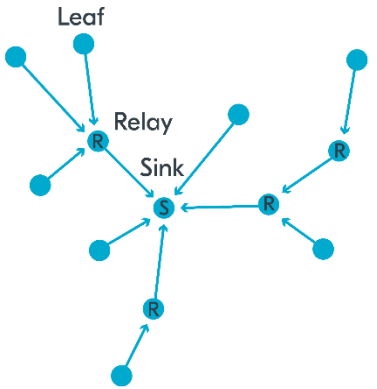
- Solutions today tend to be limited and costly
  - Wired communication with limited reach, high install, and maintenance cost
  - Solutions tend to be custom and proprietary with limited scalability
  - Cannot scale to very dense networks that are required to take full effect

- Industrial environments are challenging for most wireless communication
  - Congested ISM bands, low range, data rates, and reliability
  - Reflections, multi-path, metal and moving objects
  - Fragmented regulatory landscape for wireless options

* McKinsey Global Institute

Industrial IoT: How Can NR+ help

- Ultra Reliable Operation NR+ Physical layer
  - Access to non-congested global spectrums with
  - Radio with dynamic output power, switching to the lowest interference channels, and more
  - Proven in cellular infrastructure: HARQ, Forward Error Correction, multiple coding schemes, …
- High flexibility down to each leaf node
  - Local networks, private, secure with both IP or non-IP protocol options possible
  - Internet/cloud connectivity using TCP/IP and standardized internet security protocols
- High level of dynamic adaption and mesh networking
  - Scan and track potential relays to switch and route through
  - Multiple sinks (gateways) to add network redundancy are possible
  - Broadcast and multicast groups for efficient spectrum usage



Industrial IoT: NR+ Star Network Reliability

- Star Networks
  - Optimal to achieve the most consistent and lowest latency performance
  - Simple deployment model with more modest demand on nodes

- NR+ Star Network for low latency
  - Inherent 1mS low latency operation built into the radio standard
  - The Sink can control channel time and time usage to avoid interference
  - Link resource reservation possibility to prioritize certain traffic or devices in a network

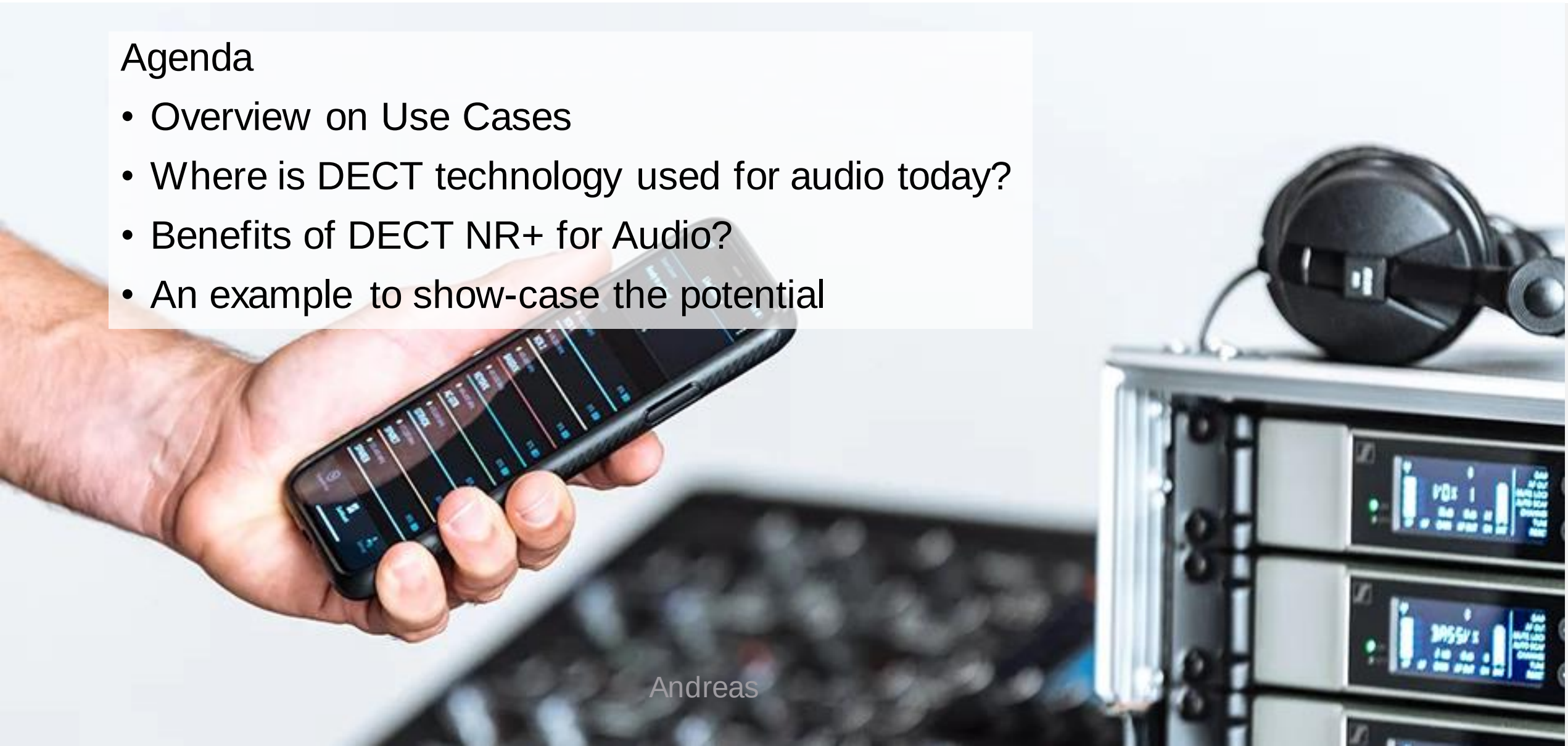
- Star Network Reliability
  - Multiple link options to get messages from duplicate transmissions if original is lost
  - Sink-to-leaf messages, but also leaf-to-leaf or leaf under 2 sinks (in 2-star option setup)

- Multiple Stars option
  - A device can have multiple sinks and addressing is independent of the network
  - Devices can scan and track alternative sinks if available and send with the lowest cost option

Professional Audio

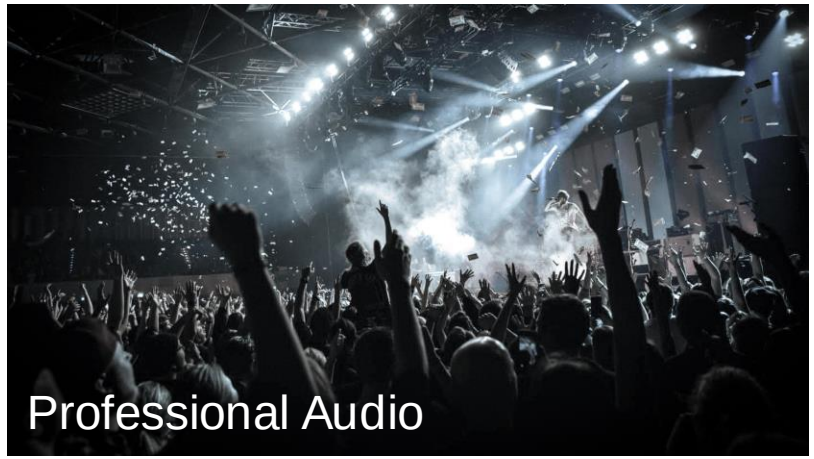
Agenda

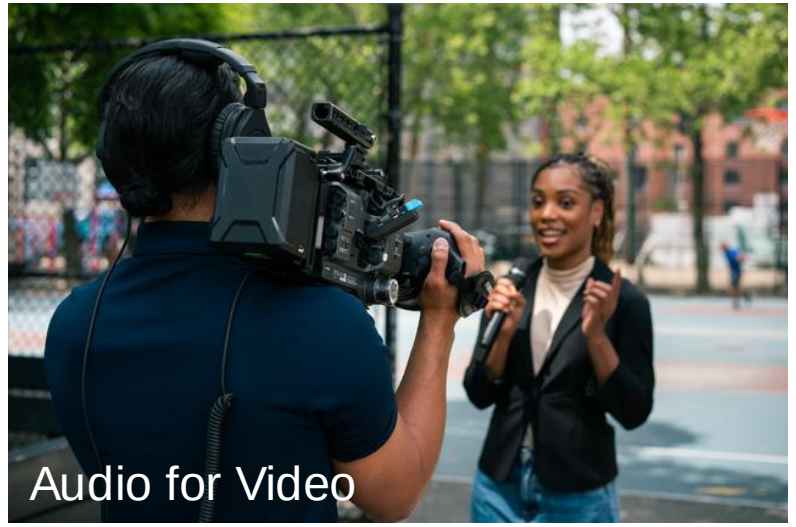
- Overview on Use Cases
- Where is DECT technology used for audio today?
- Benefits of DECT NR+ for Audio?
- An example to show-case the potential



Andreas

Some use cases …





Where is DECT Technology for Audio used today?

- Audio for Video
- Education
- Conferencing
- Headsets

Benefits of DECT NR+ for Audio Industry

- Modern PHY of DECT NR+ allows use even in complex environments and large halls.
- IMT-2020 technology, which is no longer restricted to the DECT band. Built-in support for reliable spectrum sharing.
- Scalability and flexibility of PHY/MAC engine.
- Ease of use including automatic interference handling.
- Support of various network topologies
  - Cable replacement
  - Star topology
  - Mesh topology, might be interesting for Tour Guide like applications
- „Anywhere, at Anytime, by Anyone“ for demand-driven user deployment.
- Chipset-based solution, while providing freedom to innovate.

Convergence incl. E2E security
DLC
MAC
PHY

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Research and Demonstration Project:
Media and Event production via Resilient Communication on IoT Infrastructure (MERCI)

- Franco-German innovation project on “Private 5G Networks for the Industry”.
- The MERCI project aims to develop innovative solutions for private 5G networks based on or complemented by DECT-2020 NR.
- This will be done through cooperative integration of
  - the **media & event sector**, manufacturing/producing content up to distribution to the audience,
  - with the **(industrial) IoT sector**,

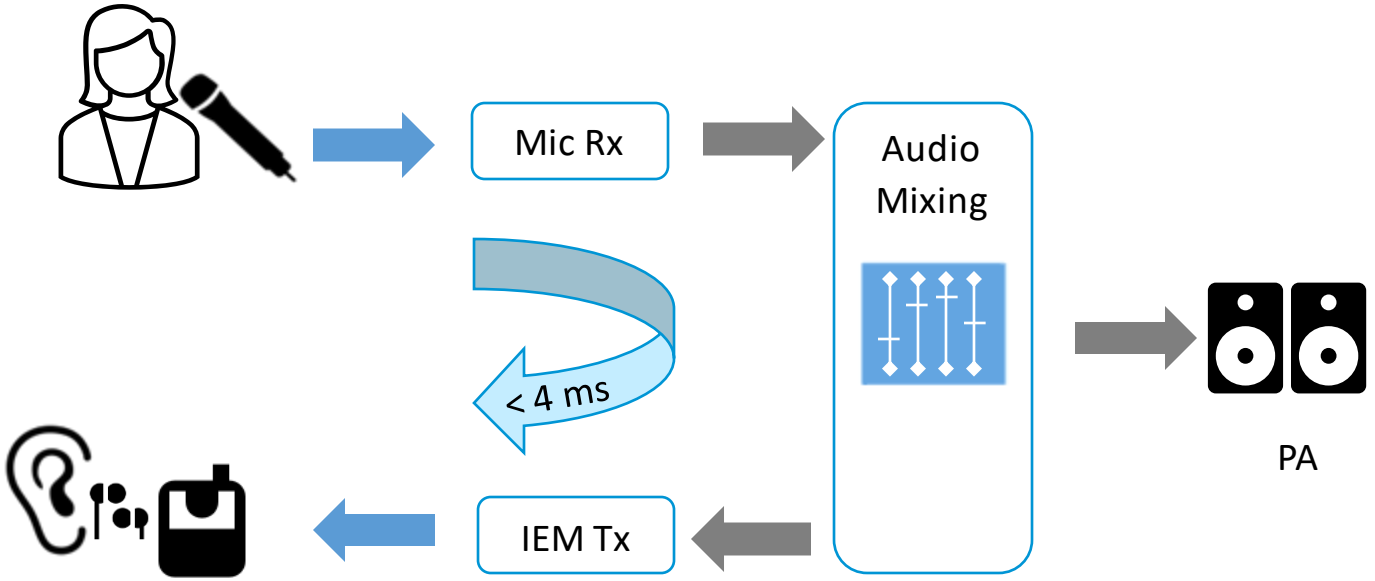
  as it is known that both application areas have similar interests and needs in use and standardization.
- Main Targets:
  - Application-driven evaluations and demonstrations in E2E use cases.
  - Ready to go interworking and interfacing solutions for integration of DECT-2020 NR into existing industry eco-systems.
  - Spectrum Access and Spectrum Sharing Frameworks

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages
MINISTÈRE DE L'ÉCONOMIE, DES FINANCES ET DE LA RELANCE
Liberté Égalité Fraternité

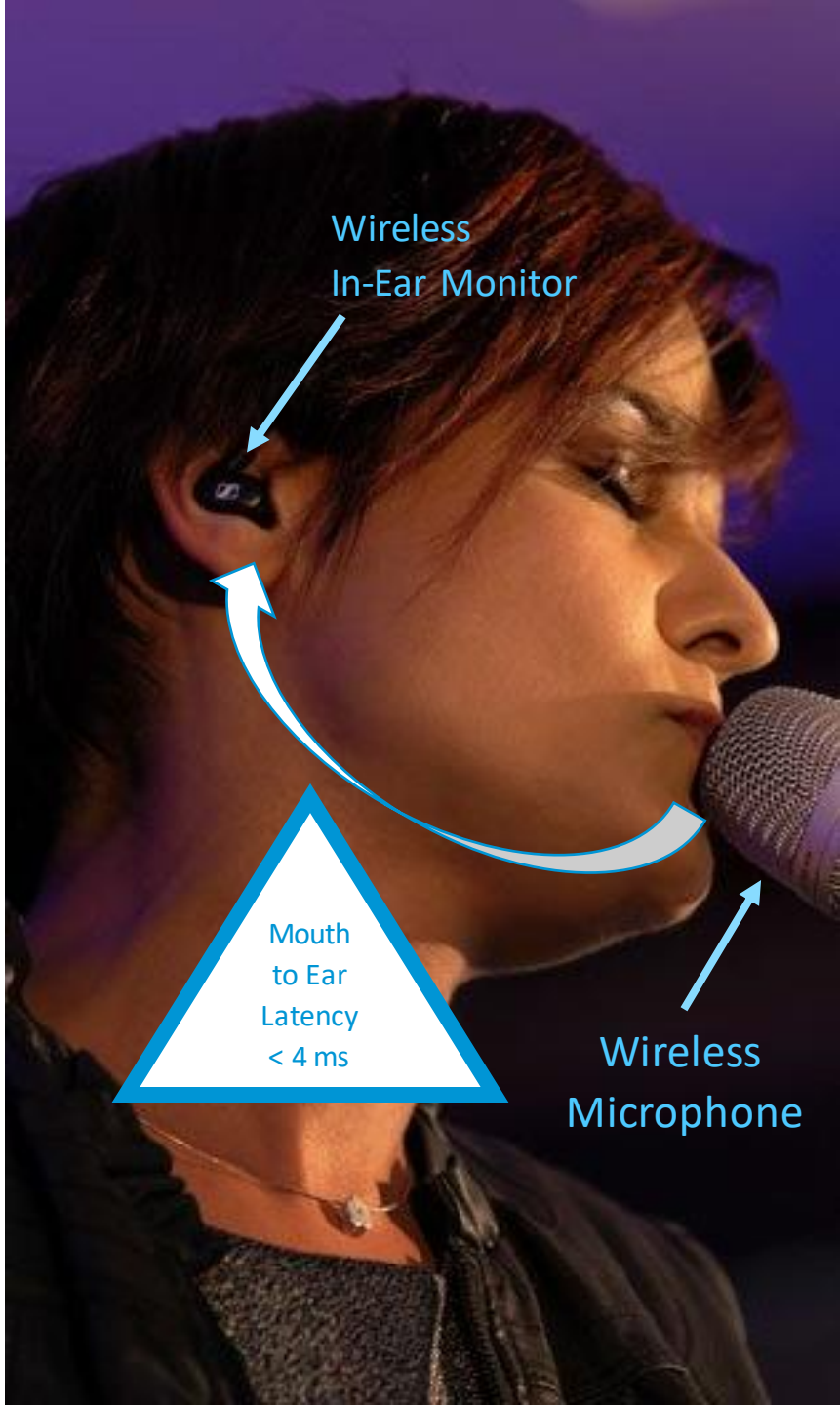
SENNHEISER RFmondial RELIABLE REAL-TIME RADIO Leibniz Universität Hannover Ostfalia University of Applied Sciences

ATEME Captivate your audience VITEC Wirepas

Latency Budget



- Artist is source and sink of audio!
- Sound is also traveling directly via the bone and body, and indirectly via room reflections (isolating headphones required).
- A jitter-free turn-around streaming latency of below 4 ms on application layer is required as the artist is source and sink of audio.



Reference: Midrange UHF Wireless Microphone System

5 Transmitter

5 Receiver

- **Sennheiser EW-DX**
  - TV-UHF, duplex gaps: 800 MHz, 1,8 GHz
  - Bandwidth: 200 kHz + guards
  - Audio Dynamic Range 134 dB
  - **Codec data rate: 187,5 kbit/s**
  - **1,9 ms system latency**
    (capsule to receiver output)
  - Efficiency
    - 1,65 ch/MHz (standard mode)
    - 3,33 ch/MHz (link density mode)
  - Control Plane via Bluetooth

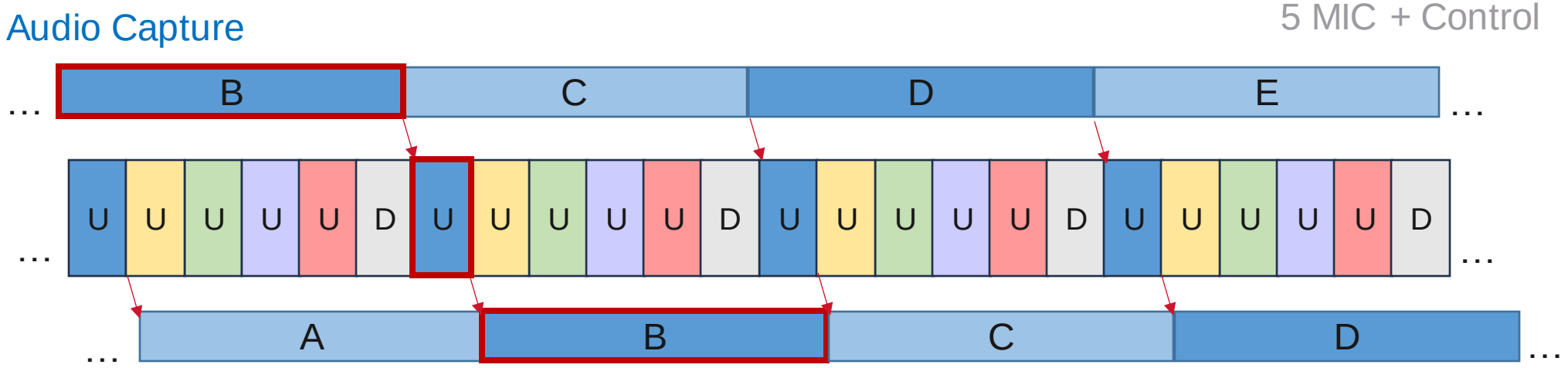
5 ch / (1,65 ch / MHz) = 3,03 MHz (standard mode)

5 ch / (3,33 ch / MHz) = 1,501 MHz (link density mode)

Is it possible to realize such a MIC system with DECT NR+?

Scheduled Access

5 MIC + Control



Streaming Latency: 6 (sub-)slots + 1 (sub-)slot + processing

(1,1)	B=1,728 MHz,	T_{slot}= 416,67 µs, ΔT_{stream}= 2,9167 ms + processing
(2,1)	B=3,452 MHz,	T_{slot}= 208,33 µs, ΔT_{stream}= 1,4583 ms + processing

PHY Data Rate

(1,1)	16-QAM / r=1/2	D = 4 slots x 616 bit/slot / 10 ms = 246,4 kbit/s
(2,1)	16-QAM / r=1/2	D = 8 slots x 772 bit/slot / 10 ms = 617,6 kbit/s
(2,1)	QPSK / r=1/2	D = 8 slots x 380 bit/slot / 10 ms = 304,0 kbit/s

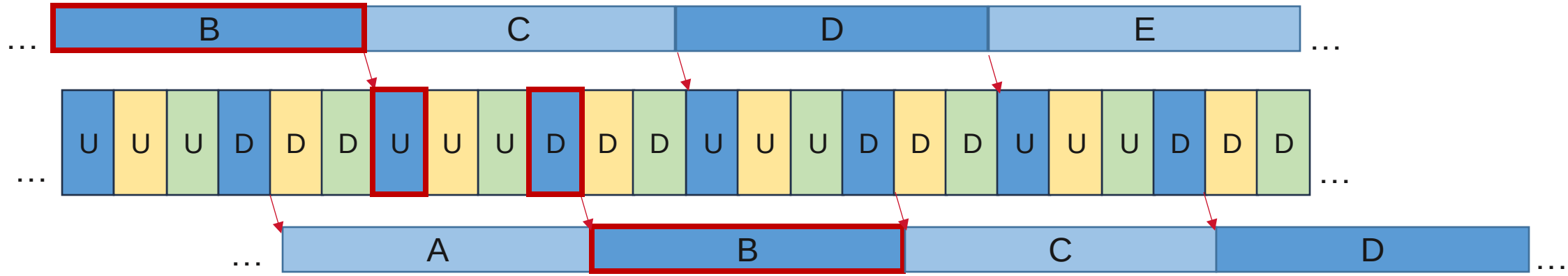
2,89 ch/MHz (1,1)

1,49 ch/MHz (2,1)

Is it possible to realize a MIC+IEM system with DECT NR+?

Scheduled Access

3 MIC + 3 IEM + Control



Streaming Latency: 6 (sub-)slots + 4 (sub-)slot + processing

(1,1)	B=1,728 MHz,	T_{slot}= 416,67 µs, ΔT_{RTrip}= 4,167 ms + processing
(2,1)	B=3,452 MHz,	T_{slot}= 208,33 µs, ΔT_{RTrip}= 2,083 ms + processing

PHY Data Rate

(1,1)	16-QAM / r=1/2	D = 4 slots x 616 bit/slot / 10 ms = 246,4 kbit/s
(2,1)	16-QAM / r=1/2	D = 8 slots x 772 bit/slot / 10 ms = 617,6 kbit/s
(2,1)	QPSK / r=1/2	D = 8 slots x 380 bit/slot / 10 ms = 304,0 kbit/s

3,47 ch/MHz (1,1)

1,73 ch/MHz (2,1)

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Topics in the webinar series

	Topics	Dates
#1	Introduction to NR+ and DECT Forum	April 20
#2	Applications and use cases	May/June
#3	The technology (upper layers)	September
#4	The technology (lower layers)	October
#5	How to get started with NR+	November
#6	Recap and panel discussion	December

DECT NR+ webinar series

- We hope you enjoyed this webinar!
- Be part of shaping the NR+ journey and join us at the DECT Forum!

  https://www.dect.org/application-for-membership.aspx
- Contact roel.ottink@dect.org for information
- Question time

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